# DEVICE FOR ASSISTING TRAVELING OF VEHICLE

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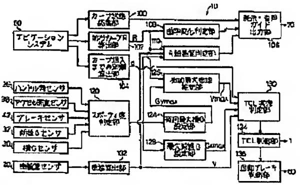
Abstract of **JP10269495**

PROBLEM TO BE SOLVED: To enable a driver to easily and surely grasp curve information in the front of a vehicle and to improve the driving capacity of the vehicle by detecting the existence of at least one curve on a road in front of the vehicle and displaying curved direction information and difficulty information on a visual display or the like prior to entrance into the curve. SOLUTION: When the curve state of a curved road is recognized based on information from a navigation system 50 and the radium R of curvature of the curved road is calculated, a curvature change judging part 108 computes a change in the radius R of curvature on one curved road and judges whether the radius R of curvature is a curve to be gradually increased and moderated or a curve to be gradually reduced and sharpened. An R difficulty judging part 110 judges the difficulty of the radius R of curvature, i.e., whether the radius R is large or not and the manipulated variable of a turned hundle is small or not, based on the calculated radius-of-curvacture information on the curved road. A display/voice guide output part 106 outputs the information on a change in curvature, R difficulty, etc., to a voice guiding device 70.



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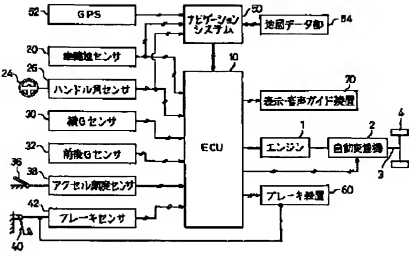
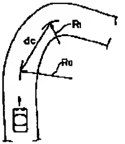
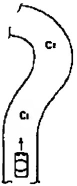
【図１】


52
GPS
50
ナビゲーションシステム
地図データ部
54
20
車輪速センサ
26
24
ハンドル角センサ
10
70
表示・音声ガイド装置
30
横Gセンサ
1
2
4
ECU
エンジン
自動変速機
32
前後Gセンサ
3
36
38
アクセル開度センサ
60
ブレーキ装置
42
ブレーキセンサ
LS
40

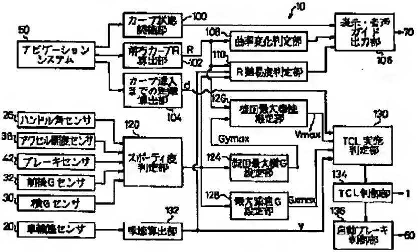
【図３】


R1
dc
R0

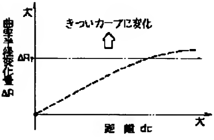
【図７】


C2
C1

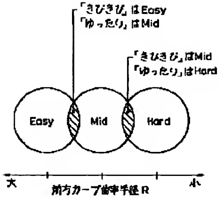
【図２】


10
カーブ状態認識部
100
50
108
曲率変化判定部
表示・音声ガイド出力部
70
ナビゲーションシステム
前方カーブR算出部
R
102
110
106
R難易度判定部
カーブ進入までの距離算出部
d
126
旋回最大車速推定部
104
26
ハンドル角センサ
120
130
38
アクセル開度センサ
Gymax
Vmax
TCL実施判定部
42
ブレーキセンサ
スポーティ度判定部
124
旋回最大横G設定部
32
前後Gセンサ
134
30
横Gセンサ
128
最大減速G設定部
Gxmax
TCL制御部
1
132
136
20
車輪速センサ
車速算出部
V
自動ブレーキ制御部
60

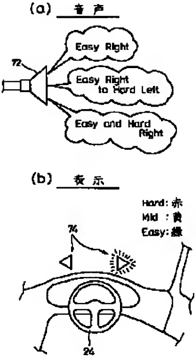
【図４】


大
曲率半径変化量 ΔR
きついカーブに変化
ΔR1
距離 dc
大

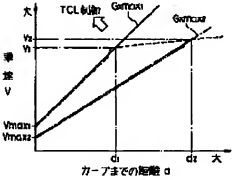
【図5】


「きびきび」はEasy
「ゆったり」はMid
「きびきび」はMid
「ゆったり」はHard
Easy
Mid
Hard
大
前方カーブ曲率半径R
小

【図6】


(a) 音声
72
Easy Right
Easy Right to Hard Left
Easy and Hard Right
(b) 表示
Hard: 赤
Mid : 黄
Easy: 緑
74
24

【図8】


大
TCL制御
Gxmax1
Gxmax2
V2
V1
車速V
Vmax1
Vmax2
d1
d2
大
カーブまでの距離 d

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the traveling auxiliary device of vehicles, and a driver is related with the traveling auxiliary device which planned the curve situation of the vehicle front exactly so that grasp was possible.
[0002]
[A related background art] In recent years, the present running position of vehicles is recognized on a map using the information from a global positioning system (GPS) etc., and the navigation system which can be transmitted to a driver is used abundantly in position information by the picture on a display. Thereby, the driver in particular cannot need a navigator (guide), but ** can also always grasp a vehicle position, the traveling direction of vehicles, etc. certainly.
[0003]By these days, using various information on this navigation system, while raising the driving operability of vehicles further, it considers controlling vehicles to a proper run state. According to JP,H4-236699,A, it asks for the characteristic of the curve of navigation system information empty vehicle both the front, and the equipment constituted so that a driver might be notified, when it was size is indicated rather than the proper revolution vehicle speed in the curve with the characteristic concerned in the present vehicle speed (curve penetration vehicle speed).
[0004]According to JP,H5-141979,A, the curvature radius R of the curve of navigation system information empty vehicle both the front is searched for, The equipment constituted so that cautions might be urged to a driver, when the lateral acceleration predicted when it advances into the curve of the curvature radius R concerned with the present vehicle speed was size from the standard lateral acceleration (threshold value) in the curve of the curvature radius R concerned is indicated.
[0005]According to JP,H6-36187,A, it asks for the proper revolution vehicle speed in the curve ahead of both [ navigation system information empty vehicle ], It asks for the deceleration which will be demanded by the time it becomes this proper revolution vehicle speed from the present vehicle speed, and when this deceleration becomes large rather than the safety-standards deceleration set

up beforehand, while giving an alarm to a driver, the equipment constituted so that deceleration control of the vehicles might be carried out is indicated.

[0006]

[Problem to be solved by the invention]It comprises equipment indicated by each above-mentioned gazette so that each may emit an alarm etc. to a driver based on the curve information from a navigation system. However, by such an alarm etc., a driver can only be operated so that the vehicle speed may be reduced. That is, alarms are alarms to the last and have not given curve status information (the curve direction, the number of continuation curves, the curvature radius R, a curvature variation, etc.) to the driver. That is, during operation, a driver is in the tendency to want to get to know the above curve situations a priori, in order to determine an operation degree beforehand, but it has not replied to such a demand. These days, there is a navigation system which transmits branch information to a driver with a sound, and such a system is not provided to curve status information, either.

[0007]Therefore, in order to know a curve situation, a driver will look at the picture on the display mentioned above, but. Usually, under the situation where a curved road continues, it can be said that it is not desirable on safe for the driver to perform operation, seeing a vehicle front and to perform image confirmation operation of a display in such a situation, and it is almost difficult actually to look at the display. The picture on a display is comparatively small and it is not easy for a driver to judge a curve situation in an instant from this picture information.

[0008]A driver makes curve information of a vehicle front easy, can always grasp certainly the place which this invention was made based on the situation mentioned above, and is made into the purpose, and there is in providing the traveling auxiliary device of the vehicles which can improve the performance of vehicles.

[0009]

[Means for solving problem]In order to attain the above-mentioned purpose, in invention of Claim 1. A curve detection means detects existence of at least one curve of the road of a vehicle front, A bend direction detecting means detects the bend direction of a curve, and a curvature-radius detection means detects the curvature radius of a curve, The curvature radius detected by a curvature-radius detection means is classified into two or more difficulty fields according to the size of this curvature radius by a difficulty sorting means, The bend direction information and the difficulty information from a difficulty sorting means which are detected by the knee direction detecting means by a display voice output means are outputted with a visual indication and a sound, before the penetration to a curve.

[0010]Therefore, if a curve is detected in a vehicle front, the bend direction and curvature radius of the curve will be detected, and it will be classified into two or more difficulty fields (for example, three fields of Easy, Mid, and Hard) according to the size about a curvature radius. And the bend direction information and the above-mentioned difficulty information on a curve are outputted by the display voice output means in [ visual again ] sound before curve penetration. Thereby, even if the case where curve shape of a vehicle front cannot be recognized clearly, and a curve are composite curves

like S:00 curve, before the driver of vehicles advances into a curve, the grasp of a curve situation is certainly enabled a priori. Therefore, traveling safety improves with the performance of vehicles.
[0011]By the way, about curvature-radius information, it is outputted by one information content for every difficulty field as mentioned above here. Therefore, it is considered as the clear thing which has the brief information outputted visually and in sound, and a driver can grasp a curve situation very exactly, before advancing into a curve. It may be made to search for difficulty information based on the vehicle speed and a curvature radius.
[0012]In invention of Claim 2, a display voice output means outputs a curvature variation situation with bend direction information and difficulty information including a curvature variation detection means by which a curvature-radius detection means detects the curvature variation situation of a curve. Therefore, it will be outputted visually and in sound also about the curvature variation situation of a curve, and even if the driver of vehicles is a case where the whole curve of a vehicle front cannot be recognized clearly, before it advances into a curve, the grasp of the curvature variation situation of a curve is enabled beforehand. Thereby, traveling safety improves further with the performance of vehicles.
[0013]In invention of Claim 3, a difficulty sorting means includes the driver state detecting means which detects the operational status of a driver, and the compensation means which amends two or more difficulty fields according to the operational status of this driver. Therefore, according to taste, an amendment change of whether a difficulty field is the operational status of a driver, i.e., operation which likes a state "briskly", or it is operation which likes a state "calmly" is made, and the contents of an output from a display voice output means are made into the contents adapted to the operation intention (driving ability) of the driver. Therefore, the driver can maintain a good operation run, without sensing sense of incongruity during curve traveling.
[0014]In invention of Claim 4, a driver state detecting means, The operational status of a driver is detected based on each operation information from a braking operation detection means that the braking manipulated variable by the steering operation detection means and braking control means which detect the amount of steering operation by accelerating operation detection means to detect the amount of accelerating operation by an accelerating operation means, and a steering operation means is detected.
[0015]Therefore, detection of the operational status of a driver is certainly enabled [ easy and ] by an accelerating operation detection means, a steering operation detection means, and the braking operation detection means, without establishing a driver state detecting means separately.
[0016]
[Mode for carrying out the invention]Hereafter, with reference to Drawings, one embodiment as an embodiment of the invention is described. Reference of drawing 1 shows the outline composition of the control system of the vehicles (passenger car etc.) containing the traveling auxiliary device concerning this invention with the block diagram. As shown in the figure, it is electrically connected to the electronic control unit (ECU) 10, and operation control of the engine 1 carried in vehicles is

carried out according to the output signal from the ECU10 concerned.

[0017]The engine 1 is a gasoline engine, for example, and the output shaft is connected to the driving wheel 4 via the automatic transmission 2 and the driving shaft 3. The automatic transmission 2 contains two or more oil pressure friction engagement elements which are not illustrated, such as a hydraulic clutch and a hydraulic brake besides two or more sets of planetary gear, and it is constituted so that a gear ratio may be determined according to the combination of the engagement of the oil pressure friction engagement element of these plurality. In detail, the transmission control unit (not shown [ both ]) provided with two or more solenoid valves is provided in the automatic transmission 2 concerned, and the solenoid valve of these plurality is electrically connected to it ECU10. And if an output signal (shift signal) is supplied towards a solenoid valve corresponding, respectively from ECU10, a corresponding solenoid valve will carry out an opening and closing valve respectively, the predetermined oil pressure friction engagement element will operate, and gear change will be performed. In more detail, if it is in the automatic transmission 2 concerned, a gear ratio (target gear ratio) is determined based on the vehicle speed V and accelerator opening thetaTH from the shift map set up beforehand, the shift signal according to this is supplied to a transmission control unit, and gear change is carried out.

[0018]Since it is publicly known about the composition of the engine 1 and the automatic transmission 2, detailed explanation is omitted here. ECU10 is provided with the input/output device which is not illustrated, the memory storage (non-volatile RAM, ROM, etc.) which contained many control programs, the central processing unit (CPU), the timer counter, etc. And two or more wheel speed sensors 20 which detect the wheel rotational speed NH of each wheel of the above-mentioned driving wheel 4 grade to the input side, a steering device which performs steering of vehicles, Namely, wheel angle thetaH of the handle (steering operation means) 24. The various sensors of the G sensor before and after detecting acceleration (order acceleration Gx) of cross direction which acts on wheel angle sensor [ to detect ] (steering operation detection means) 26, horizontal G sensor [ which detects the acceleration (lateral acceleration Gy) of the transverse direction which acts on vehicles ] 30, and vehicles 32 grade are connected. From the wheel rotational speed NH detected by the wheel speed sensor 20, the vehicle speed V is computed so that it may mention later.

[0019]The accelerator pedal (accelerating operation means) 36 which adjusts the fuel supply to the above-mentioned engine 1 on vehicles, and performs accelerating operation of vehicles on them, The brake pedal (braking control means) 40 on which a braking effort is made to act is formed in the wheel of the above-mentioned driving wheel 4 grade, and to the input side of ECU10. The control input 38 of the accelerator pedal 36, i.e., the accelerator opening sensors which detect accelerator opening thetaA, (accelerating operation detection means), and the brake sensor (braking operation detection means) 42 which detects the control input of the brake pedal 40 are also connected.

[0020]The navigation system (it abbreviates to the Navi system hereafter) 50 is also connected to the input side of ECU10. This Navi system 50 The position information from the global positioning system (GPS) 52, Although it is equipment (curve detection means) which grasps the current position of vehicles on the map memorized by the map data part 54 based on the vehicle information from the above-mentioned wheel speed sensor 20 and wheel angle sensor 26 grade, and is outputted with map information (traffic information), Since it is publicly known about the composition, the explanation about the details is omitted here.

[0021]On the other hand, the brake equipment 60 which adds a braking effort to the wheel of driving wheel 4 grade besides the above-mentioned engine 1 and the automatic transmission 2 is connected to the output side of ECU10. Although the brake equipment 60 is not illustrated, mainly A hydraulic master cylinder, It is connected to the electric actuator and hydraulic master cylinder which operate the hydraulic master cylinder concerned on a high-pressure-oil way, It comprises a brake actuator etc. to which the braking operation of the disk brake (or drum brake) provided in the wheel with oil pressure is carried out, and ECU10 is actually connected to the above-mentioned electric actuator. Therefore, if a driving signal is supplied to an electric actuator from ECU10, the hydraulic master cylinder operates automatically, high-pressure oil pressure will occur, the brake actuator will operate with this high-pressure oil pressure, and a disk brake (or drum brake) will generate a braking effort. Not only an electric actuator but the above-mentioned brake pedal 40 is connected with the hydraulic master cylinder like the usual vehicles, and though natural by this, a braking operation is possible in a disk brake (or drum brake) also by operation (intention) of a driver.

[0022]The display and the voice guiding device (display voice output means) 70 are connected to the output side of ECU10.In detail, the display and the voice guiding device 70 comprise a loudspeaker (mark 72 in drawing 6), and a HUD (HUD) (mark 74 in drawing 6) which projects the triangular telltale light (or arrow telltale light) which turned the peak to the outside direction mutually on the window shield of driver's seat anterior part.

[0023]The system configuration of a traveling auxiliary device and operation which relate to this invention among the control systems of the vehicles constituted in this way hereafter are explained. If drawing 2 is referred to, the control content of the run auxiliary system performed by ECU10 will be shown by the block diagram, and the control procedure of a run auxiliary system will be hereafter explained with reference to drawing 2.

[0024]The display and voice guide system part which this run auxiliary system tells mainly to a driver that the curve situation of a vehicle front is, It comprises a speed control system part which operates a traction control system (TCL control section) and an automatic braking system according to the curve situation of a vehicle front. Accelerator operation is automatically carried out so that the vehicle speed V may turn into the set vehicle speed Vs beforehand set up according to vehicle states (lateral acceleration Gy etc.), even if TCL control is a case where the accelerator pedal 36 is operated, For example, it is a system held to the trace condition stabilized in vehicles in the curved road etc.

[0025]First, a display and a voice guide system part are explained. In [ if it is recognized that the vehicle position information from the Navi system 50 inputs into ECU10, and a curved road is located in a vehicle front ] the curve state recognition part (bend direction detecting means) 100, It is distinguished and recognized based on the information from the Navi system 50 whether the curved road's being the right curve and it being the left curve and a curved road are independent curves and whether it is a composite curve (for example, S character curve).

[0026]And in the front curve R calculation part (curvature-radius detection means) 102, the curvature radius R of the curved road (or curvature) is simultaneously computed based on the information from the Navi system 50 too. In detail, the curvature radius R is searched for here by carrying out circle approximation of the curve shape on a map, for example from the onset point, end spot, and way point of a curve. When a curved road is a composite curve, the curvature radius R is computed for every curve.

[0027]Thus, if a curve state of a curved road is recognized based on information from the Navi system 50 and the curvature radius R of a curved road is computed, About curve state information, a display and the voice guide outputting part (display voice output means) 106 are supplied, and the curvature variation judgment part 108 and R difficulty judgment part 110 are supplied about curvature-radius R information on a curved road.

[0028]In the curvature variation judgment part (curvature variation detection means) 108, data processing of the curvature-radius R information on a curved road computed as mentioned above is carried out still more finely. that is, it is a curve to which data processing of the change of the curvature radius R in a curved road of 1 is carried out, and the curvature radius R becomes loose greatly gradually -- or it is judged whether it is a curve which becomes tight small. Here, curvature-radius variation deltaR is first computed based on a following formula (1).

[0029]

Curvature-radius variation deltaR=(R1 ahead of reference point R0-distance dc)/(reference point R0) -- (1) Here the reference point R0, As shown in drawing 3, a curvature radius of a center of a curve in an onset point of a curve is shown, and, as for R1 ahead of distance dc, only the distance dc shows a curvature radius of a center of a curve in a front point from the reference point R0. The distance dc is the value determined arbitrarily.

[0030]And it is distinguished whether on a graph showing a relation of the distance dc and curvature-radius variation deltaR as shown in drawing 4, curvature-radius variation deltaR became deltaR1 or more specified values. As a result, when curvature-radius variation deltaR becomes deltaR1 or more specified values, it judges with a curved road becoming tight gradually. On the other hand, if curvature-radius variation deltaR is less than the specified value deltaR1 also in the distance dc front, it judges with a curved road having the curvature radius R same in abbreviation as a whole.

[0031]And curvature variation information searched for in this way is supplied to a display and the voice guide outputting part 106 like the above-mentioned curve state information. In R difficulty judgment part (difficulty sorting means) 110, difficulty of the curvature radius R is judged based on curvature-radius R information on a curved road computed as mentioned above. The curvature radius R greatly at the time of revolution Namely, a thing or (Easy) of the handle 24 whose control input may be small, A Type of a difficulty field of (Hard) is performed [ whether a thing which needs a control input of the handle 24 to some extent, (Mid), or the curvature radius R must operate the handle 24 greatly small at the time of revolution, and ].

[0032]Here, based on the curvature radius R, a difficulty judging map as beforehand shown in drawing 5 is provided, and difficulty (Easy, Mid, or Hard) corresponding to the curvature radius R of a curved road of a vehicle front is judged from the difficulty judging map concerned. That is, if the curvature radius R of a curved road of a vehicle front is greatly loose, it will be judged with "Easy", the curvature radius R is judged to be "Mid", when not so large, and if the curvature radius R is small tight, it will be judged with "Hard."

[0033]By the way, in this system, the degree of sportiness of vehicle running is distinguished in the degree judgment part 120 of sportiness (driver state detecting means). The degree of sportiness is an index which shows whether it is carried out "calmly" whether is it got blocked and a vehicle operation state (driver state) of a driver carries out "briskly." It can ask for this degree of sportiness easily from operating speed of the accelerator pedal 36, operating speed of the handle 24, operating speed of the brake pedal 40, etc.

[0034]That is, the variation speed deltathetaA of accelerator opening thetaA detected by the accelerator opening sensors 38 in the degree judgment part 120 of sportiness, Data processing of the variation speed of the control input of the brake pedal 40 detected by the variation speed deltathetaTH and the brake sensor 42 of wheel angle thetaTH detected by the wheel angle sensor 26 is carried out, prescribed period memory is carried out and the degree of sportiness is determined according to these memory values. That is, if the memory value of these accelerator opening variation speed deltathetaA, the wheel angle variation speed deltathetaTH, and brake-pedal-operation variation speed is large respectively, it will consider that the driver likes operation "briskly" and the degree of sportiness will be distinguished from size. On the other hand, if the memory value of the accelerator opening variation speed deltathetaA, the wheel angle variation speed deltathetaTH, and brake-pedal-operation variation speed is small respectively, it will consider that the driver likes operation "calmly" and the degree of sportiness will be distinguished from smallness.

[0035]It can ask for this degree of sportiness from the lateral acceleration Gy information from the horizontal G sensor 30, and the order acceleration Gx information from the order G sensor 32. In this case, the degree of sportiness is specified as follows. Based on lateral acceleration Gy information, the degree of tire load is first computed from a following formula (2).

(Horizontal force which acts on tire)/(the maximum grip force of a tire) -- (2) The horizontal force which acts on a tire here is searched for as a function of the lateral acceleration Gy. The maximum grip force of a tire is the weighted solidity of a tire.

[0036]Based on order acceleration Gx information, the degree of engine load is computed from a following formula (3).

(Order acceleration Gx) / (maximum acceleration which can be generated) -- (3) The maximum acceleration which can be generated here is a value based on weight of vehicle and the characteristic of the engine 1.

[0037]And frequency distribution is searched for from these tire load degree information and engine load degree information, Consider that the driver likes operation "briskly", judge the degree of sportiness to be size, so that the frequency where both the degree of tire load and the degree of engine load become large is high, and on the other hand, if frequency when both the degree of tire load and the degree of engine load are small is high, It considers that the driver likes operation "calmly" and the degree of sportiness is judged to be smallness.

[0038]Thus, determination of the degree of sportiness will also supply the degree information of sportiness concerned to the above-mentioned R difficulty judgment part 110. And based on this degree information of sportiness, the difficulty judging of a portion with which the field shown with the slash, i.e., the portion with which "Easy" and "Mid" lap, and "Mid" and "Hard" lap into above-mentioned drawing 5 is performed. That is, amendment of a difficulty field is performed according to the degree of sportiness (compensation means).

[0039]That is, the degree of sportiness is size, and when the driver likes operation "briskly", the difficulty of the portion with which "Easy" and "Mid" lap is judged to be "Easy", and is judged in the portion with which "Mid" and "Hard" lap to be "Mid." Namely, when the driver likes operation "briskly." It can consider that the operation in which it is good and a driver is quick is possible for the adaptability (response) to the road state of a driver, and in this case, even if the curvature of a curved road is somewhat large, difficulty is judged to a small side ("Easy" and "Mid").

[0040]On the other hand, the degree of sportiness is smallness, and when the driver likes operation "calmly", the difficulty of the portion with which "Easy" and "Mid" lap is judged to be "Mid", and is judged in the portion with which "Mid" and "Hard" lap to be "Hard." Namely, when the driver likes operation "calmly." It can consider that the adaptability (response) to the road state of a driver is not so high, and in this case, even if it is a case where some are considered for the curvature of a curved road to be small, in consideration of safety, difficulty is judged to a large side ("Mid" and "Hard").

[0041]Based on the degree information of sportiness concerned, an amendment change also of the gear change timing on the shift map for the transmission control of the above-mentioned automatic transmission 2 is made. That is, "briskly", by operation, it is changed so that a low speed stage may be held, until the vehicle speed V becomes large comparatively, and "calmly", by operation, it is changed so that it may change gears to a high speed stage comparatively, when small [ the vehicle speed V ]. However, about the transmission control concerned, since it is not directly related here, detailed explanation is omitted.

[0042]And a display and the voice guide outputting part 106 are supplied also about the difficulty information on the curvature radius R concerned. It may be made to search for difficulty information based on the vehicle speed V and the curvature radius R. If curve state information, curvature variation information, and R difficulty information are supplied to a display and the voice guide outputting part 106 as mentioned above, in a display and the voice guide outputting part 106, these curve state information, curvature variation information, and R difficulty information will be outputted to a display and the voice guiding device 70.

[0043]Reference of drawing 6 shows an example of the voice response and the display output in a display and the voice guiding device 70. For example, when the curved road of a vehicle front is a right independent curved road, curvature-radius variation deltaR is small and difficulty is small, while carrying out voice response like "Easy Right." from the loudspeaker 72, it is green, and the light is switched on, or the triangular telltale light on the right-hand side of HUD74 is blinked.

[0044]For example, as shown in drawing 7, on a composite curve way (S character curved road) where a curved road shifts to the left curve C2 continuously from the right curve C1. In the first right curve C1, when [ small ] difficulty is large in the next left curve C2, While carrying out voice response like "EasyRight to Hard Left." from the loudspeaker 72, first, it is green, and the light is switched on, or a triangular telltale light on the right-hand side of HUD74 is blinked, and a triangular telltale light on the left-hand side of HUD74 is shortly turned on or blinked in red after the first right curve penetration.

[0045]For example, as shown in above-mentioned drawing 3, in the curvature radius R, curvature-radius variation deltaR of a large thing which has small difficulty at first in a right independent curve in being large, [ a curved road ] While carrying out voice response like "Easy and Hard Right." from the loudspeaker 72, it is made to switch on the light or blink in back red which was green, and lit up or blinked a triangular telltale light on the right-hand side of HUD74. Or a triangular telltale light on the right-hand side of HUD74 is turned on or blinked by turns in green and red order.

[0046]Thus, by making curve state information, curvature variation information, and R difficulty information know certainly with both a display or not only a sound but a display, and a sound beforehand to a driver in curved road this side, The driver can predict the operation degree at the time of a curved road run, and it becomes possible to carry out a curved road run smoothly and safely, without carrying out rapid hand operation etc., when actually running a curved road. Especially, are trying to divide R difficulty information into three easy information content (Easy, Mid, Hard), and about a display further here, The triangular telltale light (or arrow telltale light) of two simple composition divided and provided in the legible position at right and left Green (Easy), Since it is made to switch on the light or blink that even a total of six kinds of little combination is at three yellow (Mid) and red (Hard) colors and he is trying to give curve status information to a driver, Even if vehicles are the high-speed-operation middle class even if and it is a case as there are cautions of a driver far away, the driver can recognize a display almost certainly.

[0047]Since he is trying to recognize a curved road in this invention based on the information from the Navi system 50, Even if it is a case where it is a composite curve way like S character curve of not only when it is an independent curved road, but a case [ like for example, a blind curve ] whose curved road is, or vehicles which cannot check front curve shape further, as for a driver, the curve situation of a vehicle front can be grasped good.

[0048]In the portion with which the portion with which "Easy" and "Mid" lap among the difficulty of the curvature radius R, and "Mid" and "Hard" lap in this invention. Since he is trying to change the decided result of difficulty according to the vehicle operation state (driver state) of a driver, The driving operability (drivability) of vehicles will become very good, without information content with a display and a sound becoming a thing adapted to the actual operation intention (or driving ability) of the driver, and a driver sensing sense of incongruity.

[0049]Next, a speed control system part is explained. The vehicle position information from the Navi system 50 inputs into ECU10, and if it is recognized that a curved road is located in a vehicle front, in the distance calculation section 104 to curve penetration, the distance d, i.e., the distance to a curve, until it advances into a curved road will be computed based on the information from the above-mentioned Navi system 50. And this distance information d is supplied to the TCL enforcement judgment part 130.

[0050]In the revolution maximum horizontal G set part 124, the revolution maximum width G at the time of a curved road run is set up based on the above-mentioned degree information of sportiness from the degree judgment part 120 of sportiness. That is, the maximum-permissible lateral acceleration Gymax of the lateral acceleration Gy of the vehicles by which it is generated according to a centrifugal force at the time of a curved road run is set up here. In size, when the driver likes operation "briskly", the degree of sportiness, Maximum-permissible lateral acceleration Gymax is set to value Gymax1 [ comparatively big ] (for example, 0.7G), and on the other hand, when the driver likes operation "calmly", maximum-permissible lateral acceleration Gymax is set to value Gymax2 [ a little small ] (for example, 0.5G). That is, when the driver likes operation "briskly." A driver is in the tendency briskly operated while grasping the handle 24 strongly, Even if the lateral acceleration Gy is comparatively large, a driver considers that the handle 24 is operational enough, and sets maximum-permissible lateral acceleration Gymax to value Gymax1 [ big ], On the other hand, when the driver likes operation "calmly", If a driver is in the tendency operated gently, grasping the handle 24 lightly and the lateral acceleration Gy becomes large, a driver will consider that the handle 24 cannot fully be operated and will set maximum-permissible lateral acceleration Gymax to value Gymax2 [ small ].

[0051]If the maximum-permissible lateral acceleration Gymax is set up in the revolution maximum horizontal G set part 124, Based on the curvature radius R computed in the maximum-permissible lateral acceleration Gymax concerned and the above-mentioned front curve R calculation part 120, the revolution maximum vehicle speed Vmax at the time of a curved road run is presumed in the revolution maximum vehicle speed estimating part 126. Here, the revolution maximum vehicle speed Vmax is computed and presumed from the following formula (4) thru/or (6).

[0052]

Gy=gamma-V -- (4) gamma=V-theta TH/(1+A-$V^2$) -l -- (5) R = (1+A-$V^2$) and l/theta TH -- (6) As for a yaw rate and A, a stability factor and l of gamma are wheel bases here.

[0053]Specifically the yaw rate gamma and wheel angle thetaTH are eliminated from an upper type (4) thru/or (6), it solves about the vehicle speed V, maximum-permissible lateral acceleration Gymax1, Gymax2, and the above-mentioned curvature radius R are substituted for this, and revolution maximum vehicle speed Vmax1 and Vmax2 are calculated, respectively. And revolution maximum vehicle speed Vmax1 presumed in this way and Vmax2 are supplied to the TCL enforcement judgment part 130 like the above-mentioned distance information d.

[0054]Based on the above-mentioned degree information of sportiness from the degree judgment part 120 of sportiness, the maximum deceleration G before curved road penetration is set up in the maximum deceleration G set part 128. That is, before starting a curved road run, a driver usually decelerates vehicles, but the maximum-permissible order acceleration Gxmax of the vehicles order acceleration Gx by which it is generated at this time is set up. This maximum-permissible order acceleration Gxmax is applied to the distinction threshold value of distinction of whether to carry out TCL control in the TCL enforcement judgment part 130.

[0055]In size, when the driver likes operation "briskly", the degree of sportiness, Maximum-permissible order acceleration Gxmax is set to value Gxmax1 [ comparatively big ] (for example, 1.0G), and on the other hand, when the driver likes operation "calmly", maximum-permissible order acceleration Gxmax is set to value Gxmax2 [ a little small ] (for example, 0.7G). That is, when the driver likes operation "briskly." A driver is in the tendency to make a big braking effort add to vehicles comparatively rapidly, and though the big order acceleration Gx is generated just before curved road penetration, a driver fully considers that braking is feasible and sets maximum-permissible order acceleration Gxmax to value Gxmax1 greatly. That is, priority is given to braking by a driver and TCL control is made not to carry out simply in this case.

[0056]On the other hand, when the driver likes operation "calmly", A driver tends to make a braking effort add to vehicles gently, a driver is usually slowed down quite before curved road penetration, just before curved road penetration, generating the big order acceleration Gx considers that it is difficult, and it sets maximum-permissible order acceleration Gxmax to value Gxmax2 small. That is, TCL control is made to carry out comparatively easily in this case.

[0057]The TCL enforcement judgment part 130 is supplied also about the maximum-permissible order acceleration information Gxmax concerned. In the vehicle speed calculation part 132, the present vehicle speed V is computed based on the wheel rotational speed information NH from the wheel speed sensor 20. And the TCL enforcement judgment part 130 is supplied also about the vehicle speed information V concerned.

[0058]In the TCL enforcement judgment part 130, it is distinguished whether TCL control is carried out from the revolution maximum vehicle speed Vmax called for as mentioned above, the maximum-permissible order acceleration Gxmax, the distance information d, and the vehicle speed V. If drawing 8 is referred to, the relation between the revolution maximum vehicle speed Vmax, and the distance information d and the vehicle speed V at the maximum-permissible order acceleration Gxmax will be shown, and the enforcement judging method of TCL control will be explained with reference to the figures below.

[0059]When the driver likes [ the solid line ] operation "briskly" in size among drawing 8 in the degree of sportiness, Namely, revolution maximum vehicle speed Vmax1 and maximum-permissible order acceleration Gxmax1. The distance d in the case of being (1.0G [ for example, ]) and a relation with the vehicle speed V are shown, The alternate long and short dash line shows the distance d when the driver likes operation "calmly" by smallness, namely, in case the degrees of sportiness are revolution maximum vehicle speed Vmax2 and maximum-permissible order acceleration Gxmax2 (for example, 0.7G), and a relation with the vehicle speed V.

[0060]If vehicles approach the vehicle speed V into drawing 8 in a curved road in the approximately regulated state as a dashed line shows (an arrow shows), the distance d to a curve will shift to a small side from a large side. and -- setting to the distance d1 and the vehicle speed V1, if it is a case where it is judged with the driver liking operation "briskly" -- the above -- the solid line corresponding to operation will be crossed "briskly." However, after a dashed line crosses a solid line in this way, if the distance d approaches a curved road further as it is larger than the vehicle speed V1 concerned, the vehicle speed V, In order to reduce the vehicle speed V even to revolution maximum vehicle speed Vmax1, the bigger order acceleration Gx than the above-mentioned maximum-permissible order acceleration Gxmax1 (for example, 1.0G) will be needed, and it becomes impossible to maintain an already good run state. So, when the relation (dashed line) between the distance d and the vehicle speed V exceeds the distance d of maximum-permissible order acceleration Gxmax1 (for example, 1.0G), and a relation (solid line) with the vehicle speed V in this way. Even if it is curved road this side, it is made to distinguish that TCL control is required, and a TCL start signal is outputted towards the TCL control section 134. By this, TCL control is started in the TCL control section 134, a control signal is supplied towards the engine 1, and operation control, such as fuel control, is carried out.

[0061]Actually, TCL control is performed here for the purpose of the vehicle speed V which changes the solid line top corresponding to maximum-permissible order acceleration Gxmax1 (for example, 1.0G). Thus, when TCL control is carried out, the relation (dashed line) of the actual distance d and the vehicle speed V will change along a solid line, as shown in drawing 8, and vehicles, It will slow down to fitness to revolution maximum vehicle speed Vmax1, without the maximum deceleration G exceeding maximum-permissible order acceleration Gxmax1 (for example, 1.0G) from curved road this side.

[0062]Actually, as shown in drawing 8, after a TCL start signal is outputted towards the TCL control section 134, overshooting occurs by a control delay, but this amount of overshooting is held down to the range which does not have a control top problem substantially. moreover -- setting a dashed line to the distance d2 and the vehicle speed V2, if it is a case where it is judged with the driver liking operation "calmly" -- the above -- the alternate long and short dash line corresponding to operation will be crossed "calmly." Therefore, in operation, it is "calmly" distinguished from a curved road in this way quite in this side (d2>d1) that TCL control is required, and TCL control is started at an early stage at this time. By this, the relation (two-dot chain line) of the actual distance d and the vehicle speed V will change along an alternate long and short dash line, as shown in drawing 8, and vehicles, It will slow down to fitness to revolution maximum vehicle speed Vmax2, without the maximum deceleration G exceeding maximum-permissible order acceleration Gxmax2 (for example, 0.7G) too from sufficiently this side of a curved road.

[0063]By the way, when vehicles are running at high speed, the vehicle speed V does not fall, and even if it returns the accelerator pedal 24, unless it operates the brake pedal 40 and generates a braking effort, it does not slow down vehicles. However, the accelerator pedal 24 is returned, and when a control input of the brake pedal 40 is insufficient, even if a curved road approaches, vehicles cannot already be decelerated only by TCL control. So, in the automatic-brake-control part 136, in such a case, automatic brake control is carried out, a braking effort is automatically generated with the brake equipment 60 in it, and vehicles are decelerated to it. Also in this case, automatic brake control is performed for the purpose of the vehicle speed V which changes a solid line [ corresponding to maximum-permissible order acceleration Gxmax1 (for example, 1.0G) or maximum-permissible order acceleration Gxmax2 (for example, 0.7G) ], or alternate long and short dash line top as well as a case of the above-mentioned TCL control. It is more effective, if the automatic brake control concerned is combined with the above-mentioned TCL control and it is made to carry it out here.

[0064]In the above-mentioned embodiment, while judging the degree of sportiness in the degree judgment part 120 of sportiness and presuming the revolution maximum vehicle speed Vmax in quest of the maximum-permissible lateral acceleration Gymax according to the decided result, set up the maximum-permissible order acceleration Gxmax, but. Even if a vehicle operation state (driver state) of a driver uses driver state detecting means other than a concept of the above-mentioned degree of sportiness, it can be searched for.

[0065]That is, while asking from the degree of sportiness like the above about the maximum-permissible order acceleration Gxmax for example, as other embodiments about the revolution maximum vehicle speed Vmax. Based on two or more past turning information R, i.e., curvature radius, and vehicle speed V in a curved road, the maximum-permissible lateral acceleration Gymax is once computed by the above-mentioned formula (4) thru/or the inverse operation of (6), Based on this, relation between the maximum-permissible lateral acceleration Gymax and the curvature radius R is memorized as a R-Gymax map including an interpolation value, It is suitably begun from this map to read the maximum-permissible lateral acceleration Gymax corresponding to the curvature radius R, and may be made to ask for the revolution maximum vehicle speed Vmax from the above-mentioned formula (4) thru/or (6) eventually. That is, it may be made to process the revolution maximum vehicle speed Vmax based on the past curved road revolution data statistically, without judging operation "calmly" in operation "briskly."

[0066]Without using a concept of the above degrees of sportiness entirely as other embodiments, for example (the degree judgment part 120 of sportiness in drawing 2 is not carried out), About the maximum-permissible order acceleration Gxmax, a vehicle operation state (driver state) of a driver is presumed based on speed between curves of the past plurality (average vehicle speed from an end spot of a curved road to an onset point of the next curved road), According to an estimation result of this vehicle operation state, ask for the maximum-permissible order acceleration Gxmax from a map set up beforehand, and, on the other hand, about the revolution maximum vehicle speed Vmax. It is suitably begun like the above to read the maximum-permissible lateral acceleration Gymax from a R-

Gymax map, and may be made to compute from the above-mentioned formula (4) thru/or (6). in this case, an account of the upper -- a map of the maximum-permissible order acceleration Gxmax set up beforehand, The maximum-permissible order acceleration Gxmax is set as a small value, so that it can consider that speed between curves is operation "calmly" in smallness at a value with the big maximum-permissible order acceleration Gxmax, so that it can consider that speed between curves is size and operation "briskly."

[0067]In using this means, in order not to carry out the degree judgment part 120 of sportiness in drawing 2 as mentioned above, Although a difficulty judging of a portion with which "Easy", "Mid" and "Mid", and "Hard" in a display and a voice guide system part as shown in drawing 5 lap can be performed the way things stand, According to the maximum-permissible lateral acceleration Gymax read from a R-Gymax map about this, what is necessary is just made to judge. That is, what is necessary is to judge with "Easy" and "Mid", respectively, when the maximum-permissible lateral acceleration Gymax can regard it as operation "briskly" greatly, and just to judge with "Mid" and "Hard", respectively, when the maximum-permissible lateral acceleration Gymax can regard it as operation "calmly" small on the other hand.

[0068]

[Effect of the Invention]As mentioned above, as explained in detail, according to the traveling auxiliary device of the vehicles of Claim 1 of this invention. If a curve is detected in a vehicle front, the bend direction and curvature radius of the curve will be detected, About a curvature radius, it will be classified into two or more difficulty fields (for example, three fields of Easy, Mid, and Hard) according to the size, and the bend direction information and the above-mentioned difficulty information on a curve will be outputted by the display voice output means visually and in sound before curve penetration.

[0069]Therefore, even if the case where curve shape of a vehicle front cannot be recognized clearly, and a curve are composite curves like S:00 curve, the driver of vehicles can grasp a curve situation a priori, before advancing into a curve. Thereby, traveling safety can be raised with the performance of vehicles. Since he is trying to be especially outputted by one information content for every difficulty field about curvature-radius information, it is considered as what has the briefly clear information outputted visually and in sound, therefore, as for a driver, the curve situation of a vehicle front can be grasped exactly and certainly.

[0070]Since it is outputted visually also about the curvature variation situation of a curve, and in sound according to the traveling auxiliary device of the vehicles of Claim 2, the driver of vehicles, Even if it is a case where the whole curve of a vehicle front cannot be recognized clearly, before advancing into a curve, the curvature variation situation of a curve can be grasped a priori. Thereby, traveling safety can be further raised with the performance of vehicles.

[0071]Since an amendment change of whether a difficulty field is the operational status of a driver, i.e., operation which likes a state "briskly", or it is operation which likes a state "calmly" is made according to taste according to the traveling auxiliary device of the vehicles of Claim 3, The contents

of an output from a display voice output means can turn into contents adapted to the operation intention (driving ability) of the driver, a driver can be suitably prevented from sensing sense of incongruity during curve traveling, and the driver can maintain a good operation run.
[0072]According to the traveling auxiliary device of the vehicles of Claim 4, without establishing a driver state detecting means separately, by the accelerating operation detection means, the steering operation detection means, and a braking operation detection means, operational status of a driver can be made inexpensive and can be detected easily and certainly.

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[Translation done.]